

Current Power and Energy Requirements of Forward Deployed USMC Locations



22 May 2012

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Distribution A

Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE 22 MAY 2012		2. REPORT TYPE		3. DATES COVERED 00-00-2012 to 00-00-2012	
4. TITLE AND SUBTITLE Current Power and Energy Requirements of Forward Deployed USMC Locations				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Surface Warfare Center, Carderock, 9500 MacArthur Blvd, West Bethesda, MD, 20817-5700				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Presented at the NDIA Environment, Energy Security & Sustainability (E2S2) Symposium & Exhibition held 21-24 May 2012 in New Orleans, LA.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 36	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Outline



- Introduction
- PB Location Profile
- PB Level Data
 - COC Power Data
 - Billeting Power Data
 - ECU Power Estimate
 - PB Level Power Estimate
 - Generator Usage
- Results
- Discussion

Introduction

- Problem
 - USMC does not have current operational data for power consumption, ECU utilization, and equipment loads in forward deployed locations in AFG. Without this data, implementing a strategy to reduce fuel consumption is difficult
- Purpose
 - The purpose of this analysis is to better understand the load requirements of a Company COP and below operating in

What does a typical COC load profile look like?

What does a typical Billeting load profile look like?

What is the daily load profile for a COP and below?

How are ECUs being used? What is their contribution to total load?

How can the USMC use it's resources more efficiently?



Patrol Base Profile



Distance From Leatherneck: 8km

Re-supply Convoys: Every 5-7 days

Total Generator Capacity: 115kW (260kW back-up)

Mission: Show presence and secure area around Leatherneck

Months In Place: 18

Structures: 7 BaseX-305 tents with radiant barriers, 1 Wooden Building for COC and Officer/SNCO billeting

(Power and Cooling Capacity per location: Based on online generators and ECUs)

Evaluation Site:

PB (45 Marines):	2.6 kW/Marine	8.4 kBtu/Marine
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Comparison to Other Locations:

CO COP #1 (44 Marines):	0.8 kW/Marine	2.2 kBtu/Marine
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CO COP #2 (75 Marines):	1.5kW/Marine	3.7 kBtu/Marine
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Plt PB #1 (25 Marines):	1.4kW/Marine	1.4 kBtu/Marine
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Data Collection

- Description

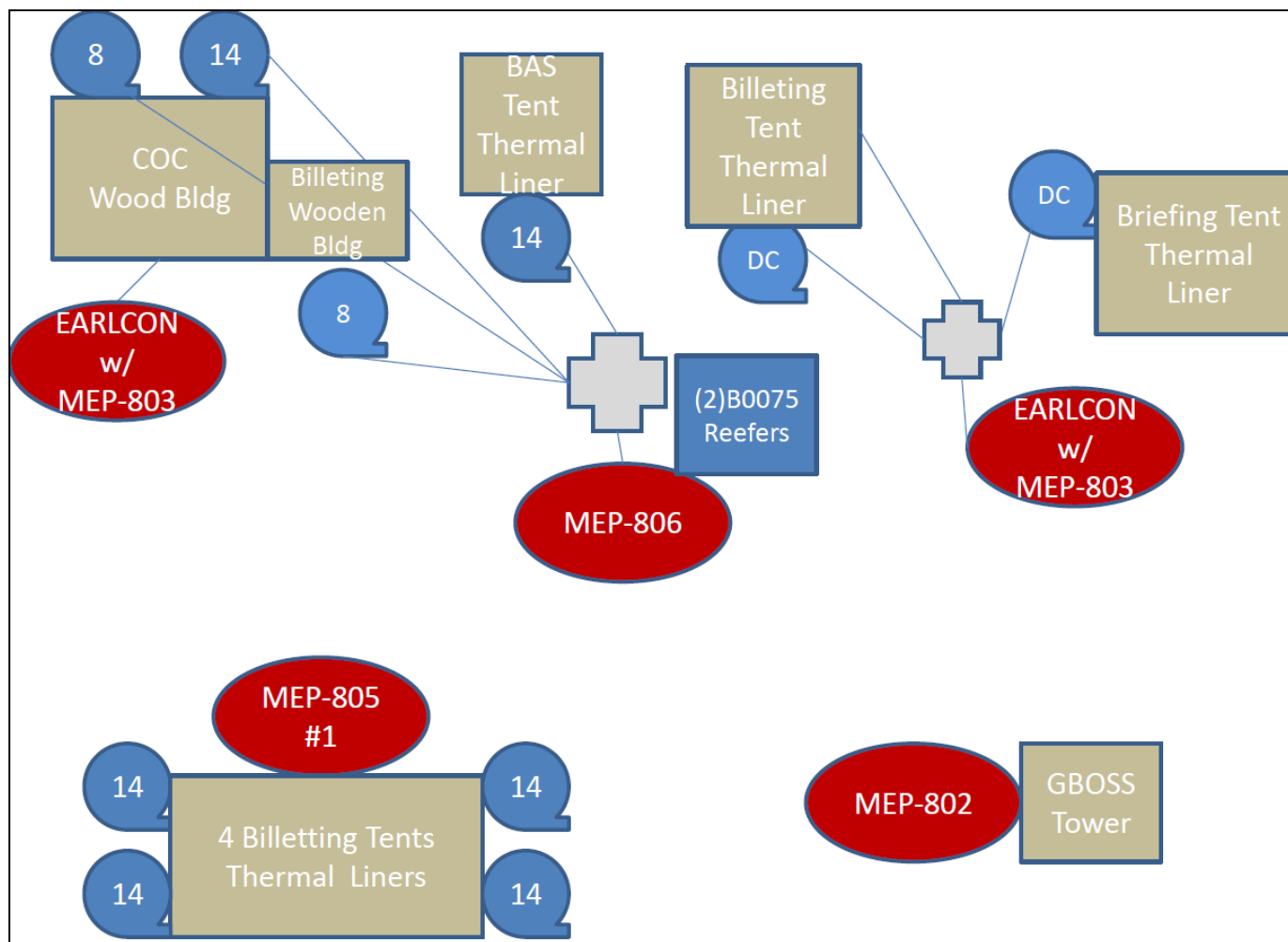
- This analysis has been generated based on data collected during two periods Aug 29th – Sept 2nd, and Sep 29th - Oct 5th 2011 at PB
- Data was gathered using “Watts-Up” power loggers, and Lascar temperature sensors at a rate of one data sample every one to five minutes
- Additional data regarding available equipment, available generators and power sources, and observed operating practices was also captured

- Data Acquisition Equipment

- All Data plotted from 0000 to 2400 each day
- 11 “Watts-up” 120VAC power monitors
- 15 Lascar Temperature Monitors
- 1 Committed Marine



Tent and Equipment Layout



ECU	Heating	Cooling	Generator	Structures
"8"	-B0008 11kW	8.5kW	MEP-802 5kW TQG	Tent -BaseX305
"14"	-B0014 9.6kW	4.5kW	MEP-803 10kW TQG	Thermal Liner – HDT Radiant Barrier
"Reefer"	-B0075 n/a	2.5kW	MEP-805 30kW TQG	Wood Bldg – Plywood construction
"DC"	-DCAC n/a	1.6kW	MEP-806 60kW TQG	

COC Equipment Inventory



A



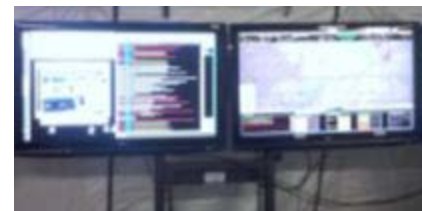
B



C



D



E



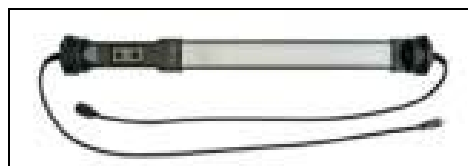
N



O



F



M



L



K



J



1



H



G

- A - Motorola Battery Charger
- B - Soldier Portable Charger
- C - PRC-152 Battery Charger
- D - CISCO 7911
- E - GBOSS Heavy (w/ 2 flat screens)
- F - Dell Laptops
- G -Wireless Point-to-Point Link (WPPL)
- H - VRC-110
- I - Blue Force Tracker
- J - Toughbook
- K - 19" flat screen
- L - PRC-150
- M - LED lights
- N – Microwave
- O – Coffee pot

Distribution A

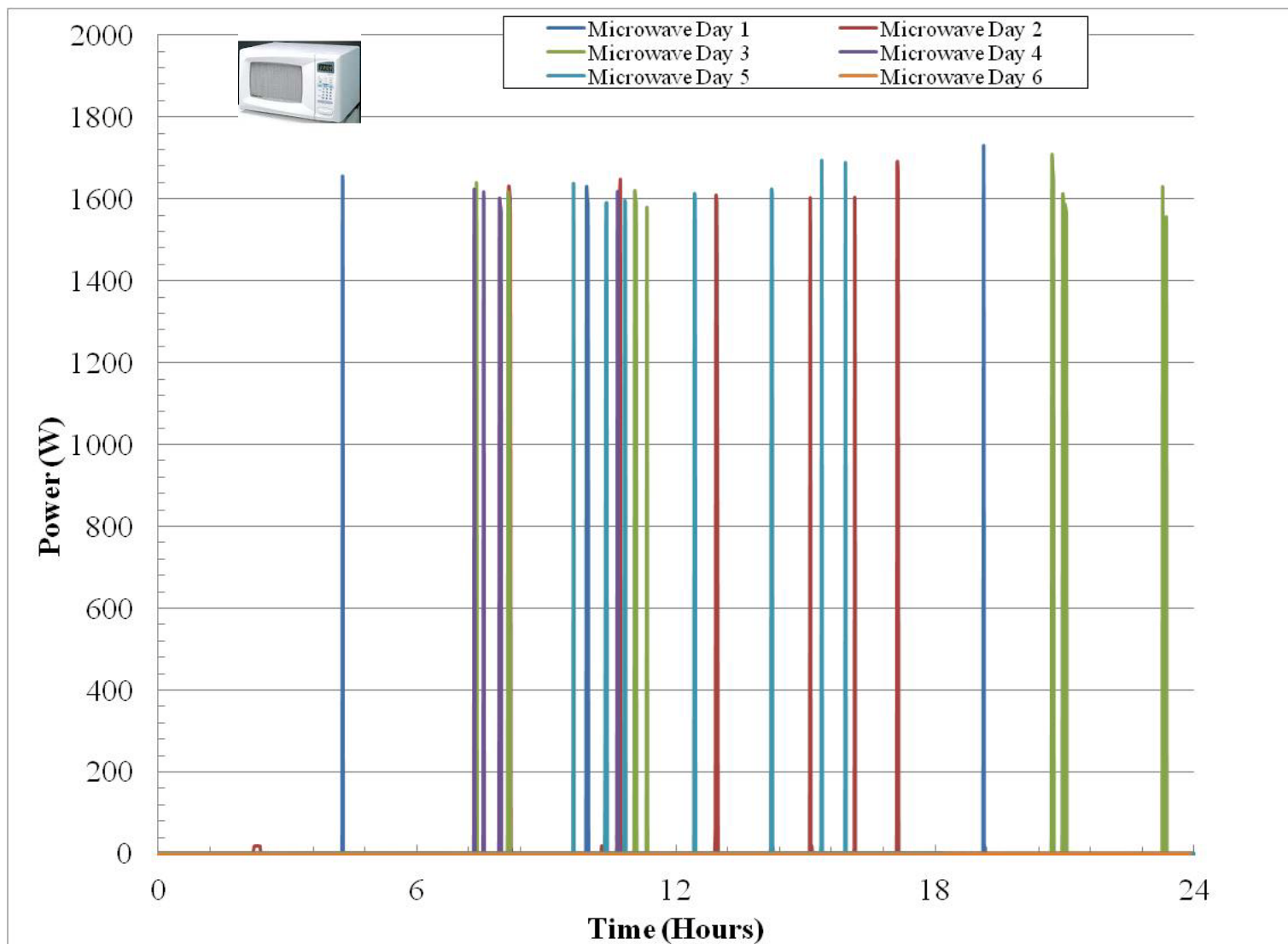
COC Equipment Comparison

	Evaluated PB	CO COP #1	CO COP #2	Plt PB #1
A - Motorola Battery Charger	-	-	-	-
B - Soldier Portable Charger	-	-	-	-
C - PRC-152 Battery Charger	-	-	-	-
D - CISCO 7911	-	-	-	-
E - GBOSS Heavy (w/ 2 flat screens)	-	-	-	-
F - Dell Laptops	-	-	-	-
G -Wireless Point-to-Point Link (WPPL)	-	-	-	-
H - VRC-110	-	-	-	-
I - Blue Force Tracker	-	-	-	-
J - Toughbook	-	-	-	-
K - 19" flat screen	-	-	-	-
L - PRC-150	-	-	-	-
M - LED lights	-	-	-	-
N - Microwave	-	-	-	-
O - Coffee Pot	-	-	-	-

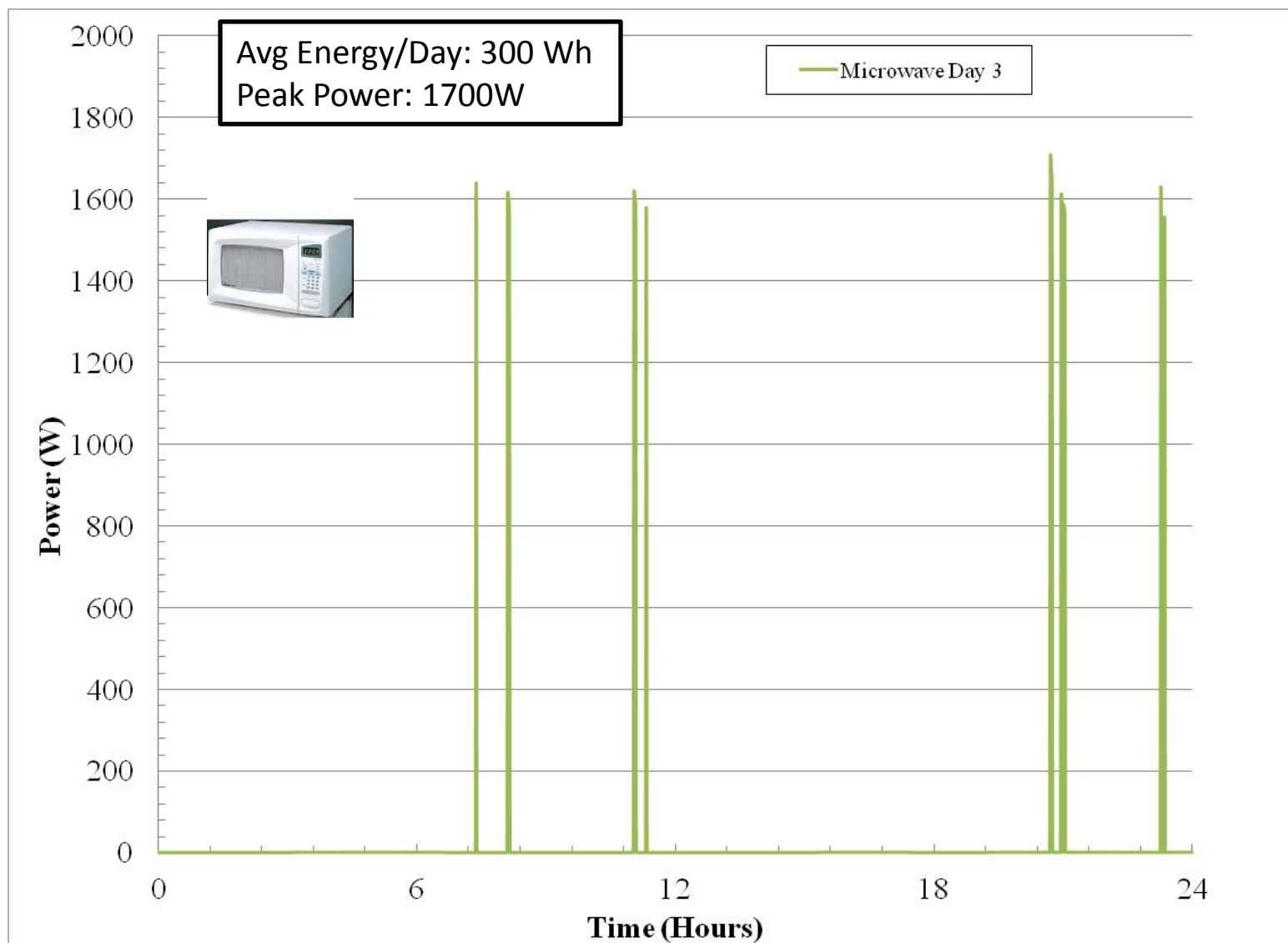
*All Company (and smaller) COCs use some variation of this equipment set

COC Equipment Power And Energy Draw 9/29-10/5

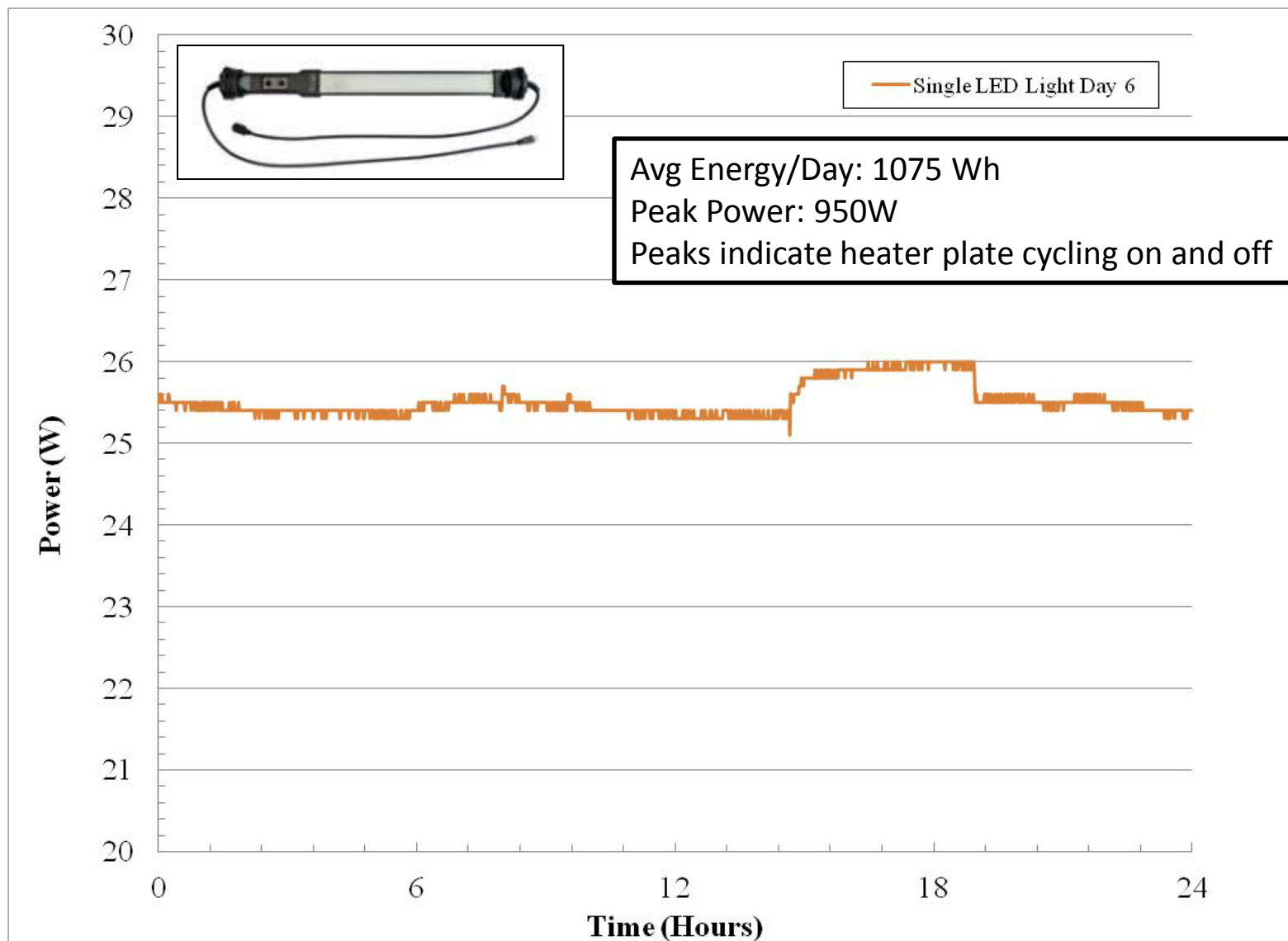
Microwave 5 Day Data



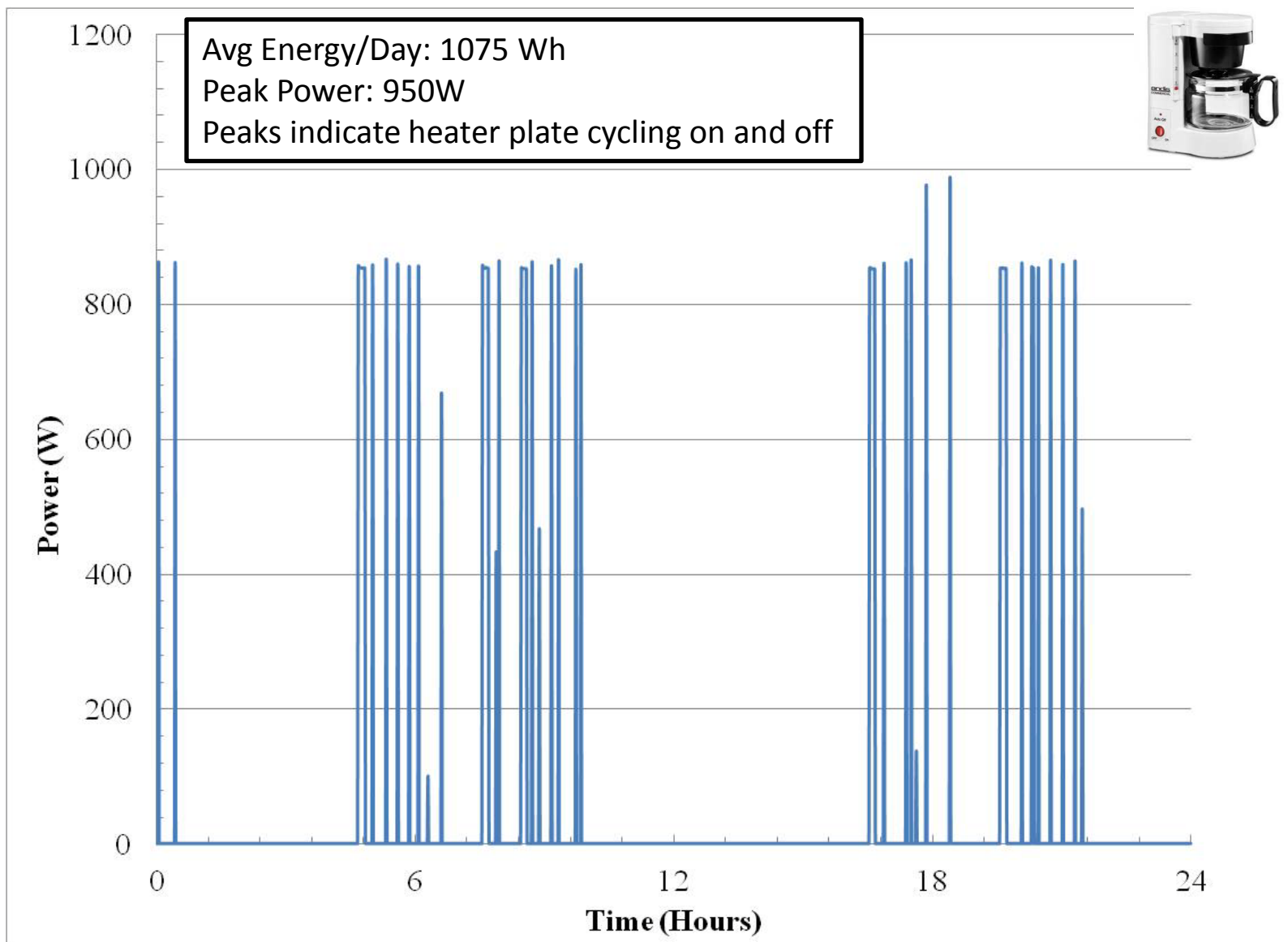
Microwave Representative Day



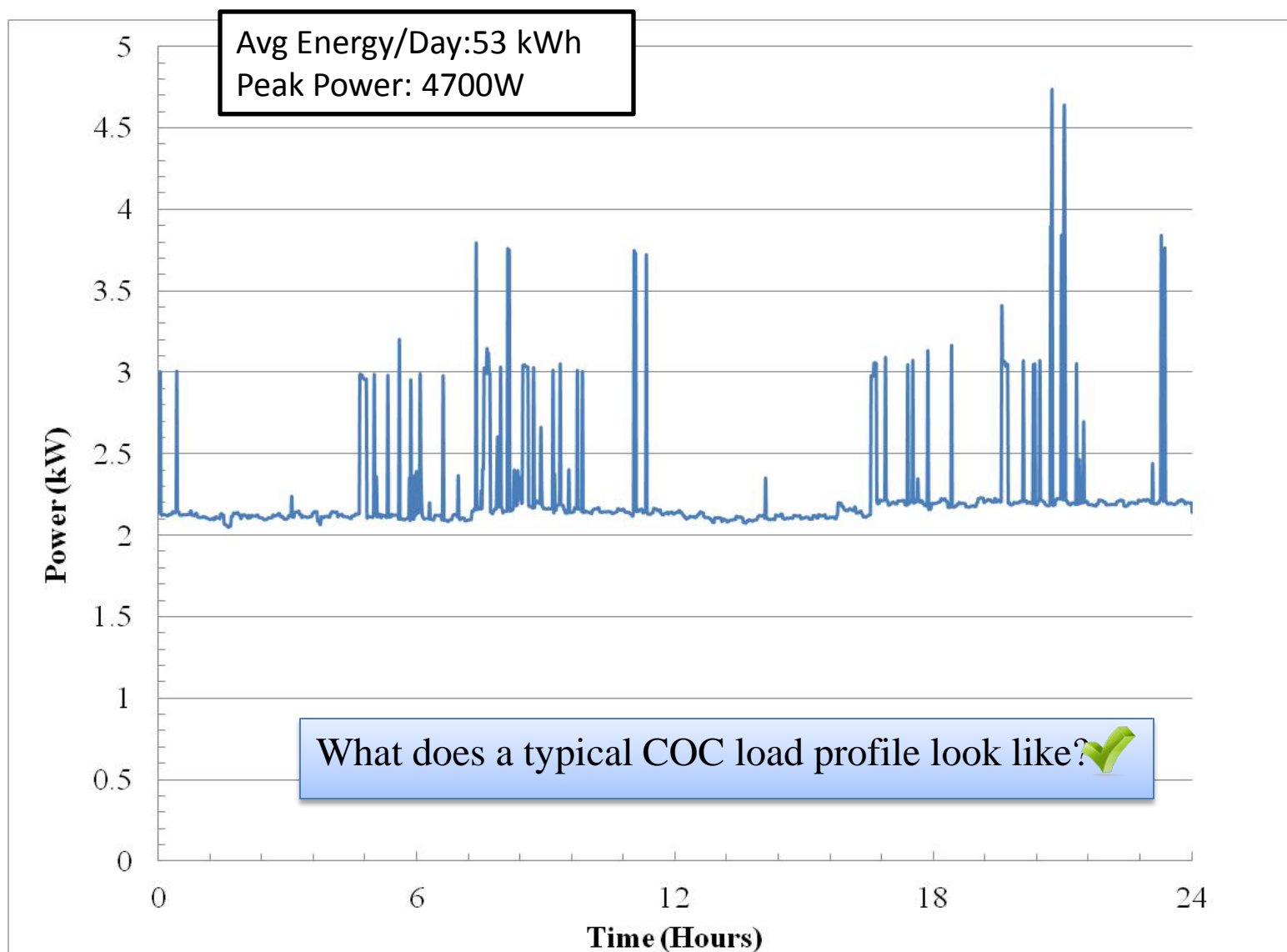
LED Lights Representative Day



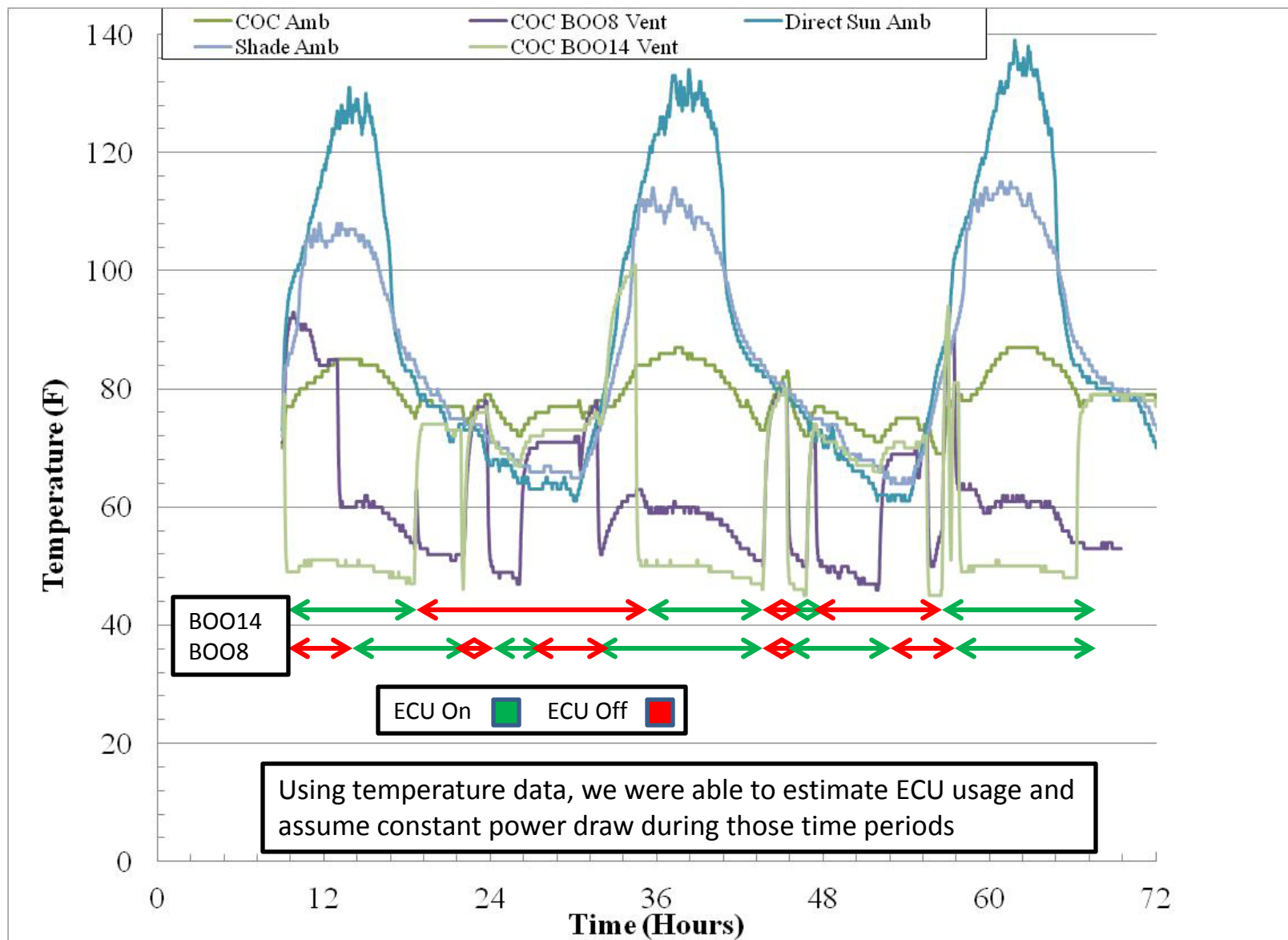
Coffee Pot Representative Day

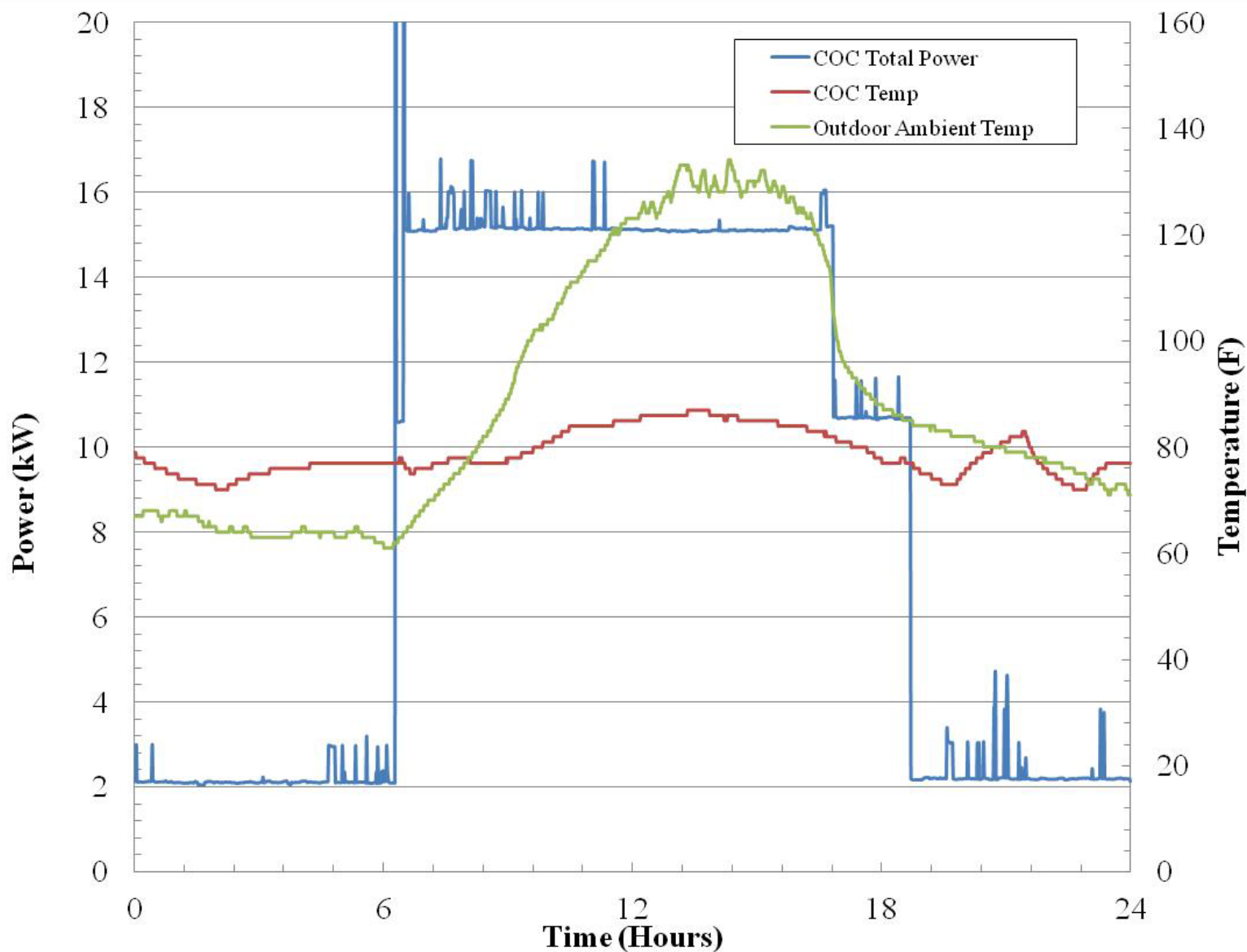


PB COC Representative 24 Hour Load



COC ECU Usage Estimate





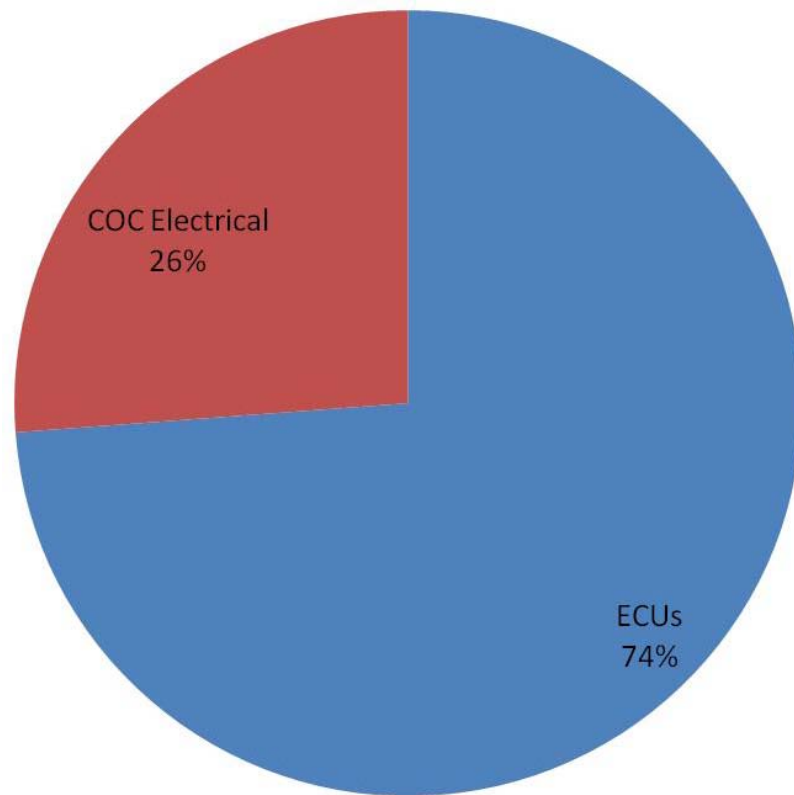
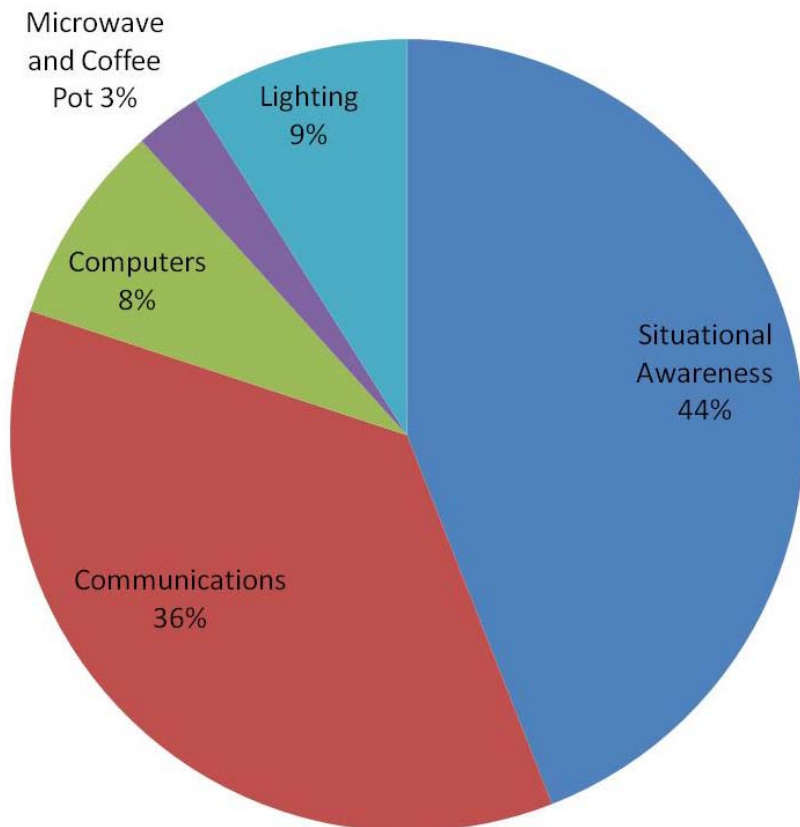
Those sections of “On” time were then combined into one large “On” time for each ECU. The steps in the load indicate the start and end of those “On” periods for each ECU

PB COC Electrical Distribution



**COC Electrical Energy
Demand Per Day (54* kWh)**

**Total COC Energy Demand
Per Day (207** kWh)**

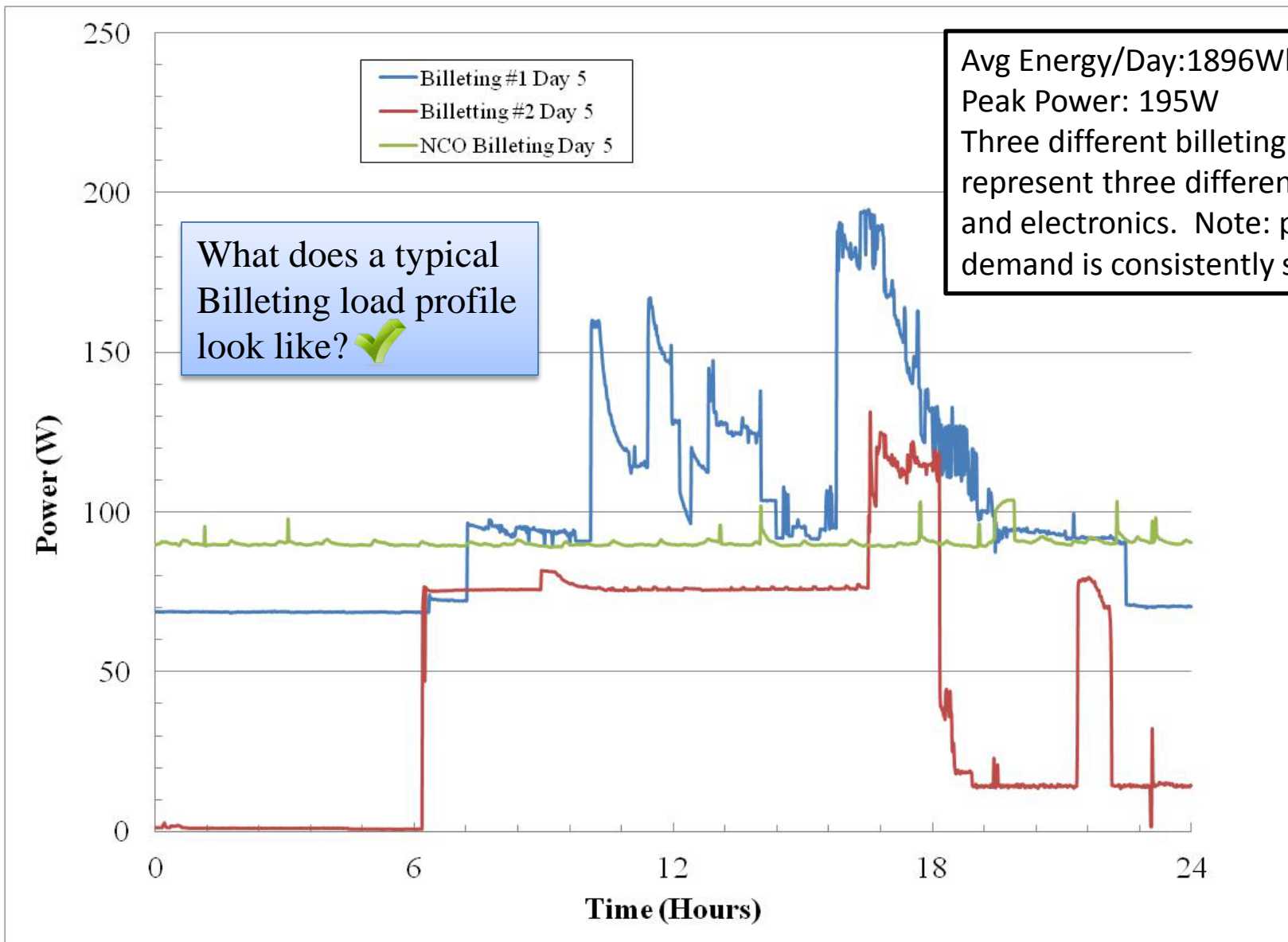


*Note: Distribution of electrical load depends on equipment onsite

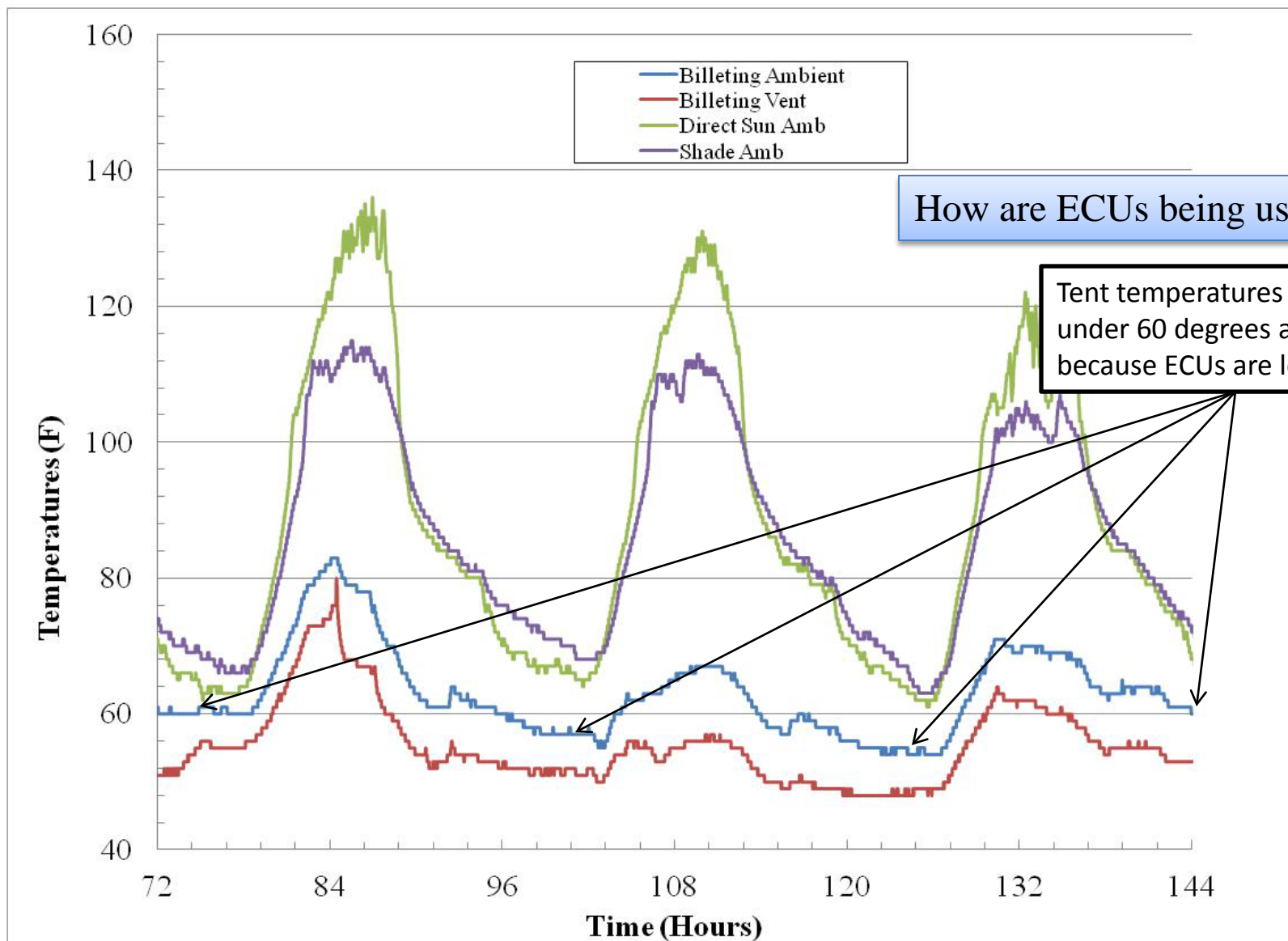
**Note: Distribution and total energy is heavily dependent on ECU availability and time of year

Billeting Equipment Power And Energy Draw 9/29-10/5

Billeting Electrical Usage



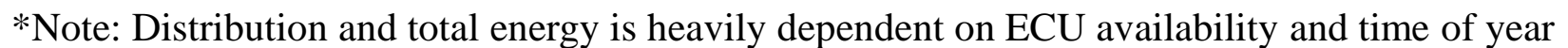
Billeting ECU Usage



How are ECUs being used? ✓

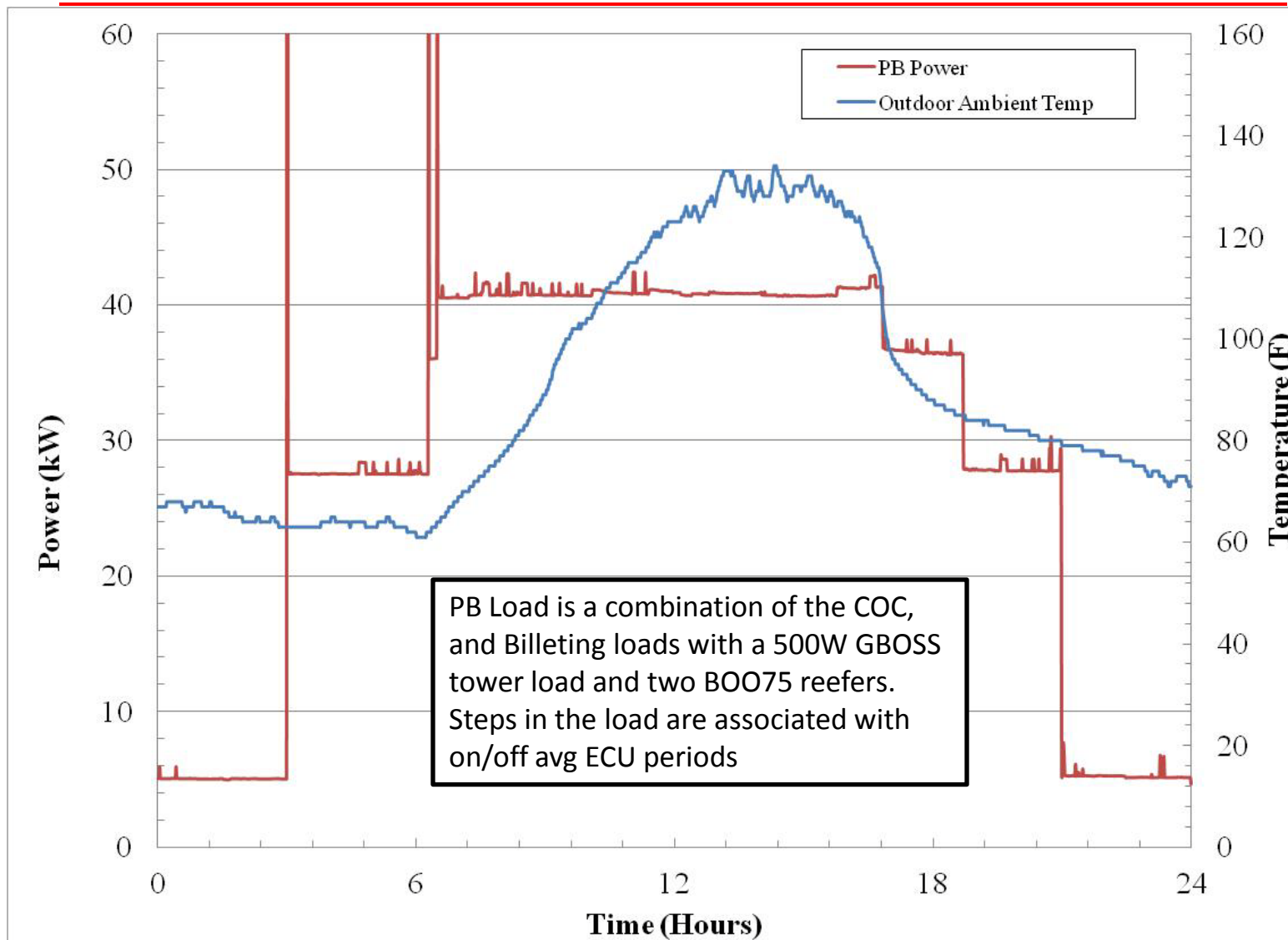
Tent temperatures drop to under 60 degrees at night because ECUs are left ON!

Daily Billeting Energy Use for 6 Tents (419* kWh)



PB Combined Power and Energy Estimates 9/29-10/5

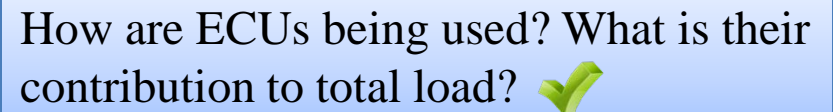
PB Load Profile



What is the daily load profile for a COP and below? 🟢

Distribution A

PB Energy Demand Per Day (685* kWh)



- 0.63 kW continuous /Marine (Avg)
- 81% of load is ECUs

Distribution A

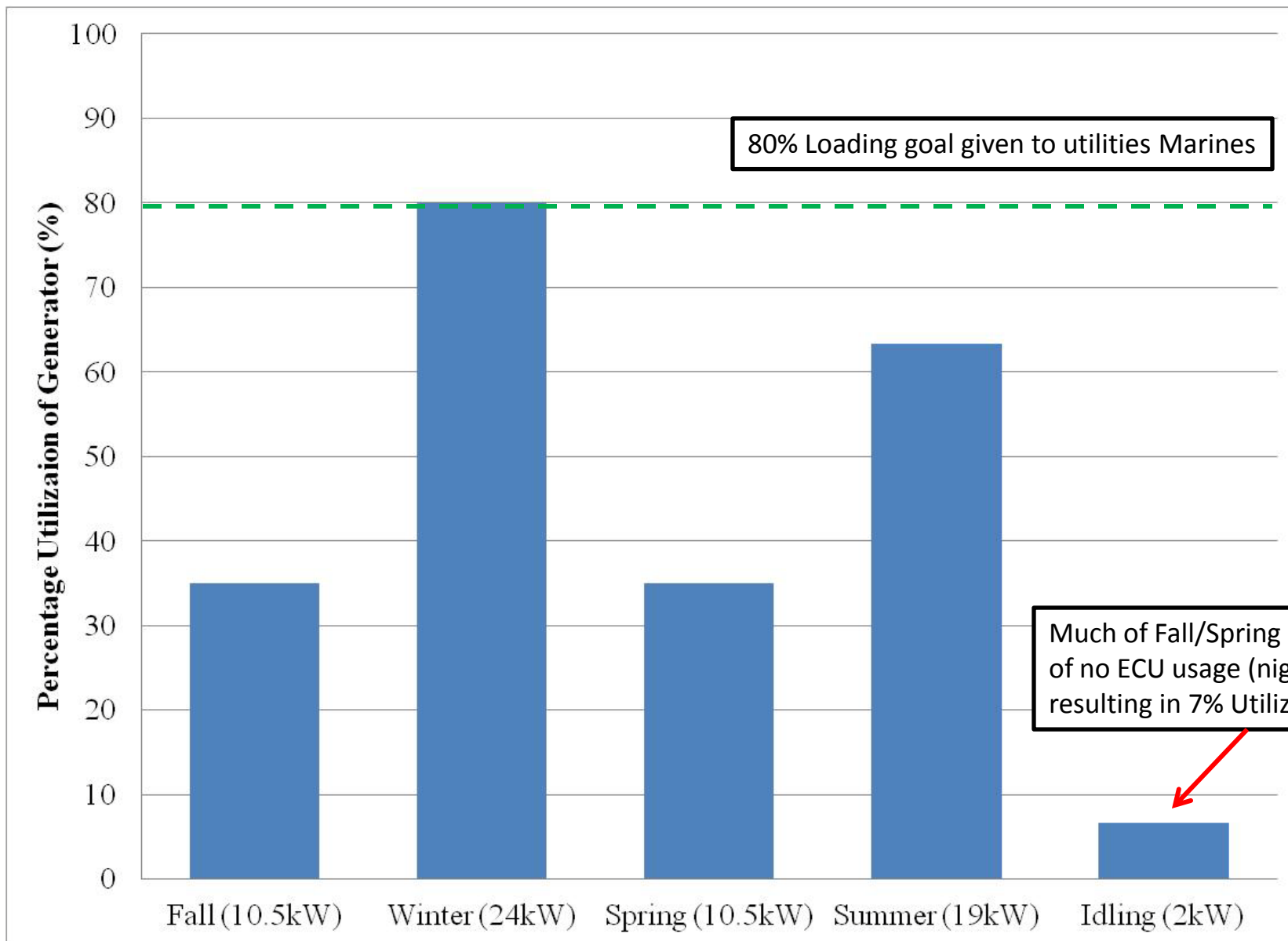
Example of Inherent Inefficiencies in the Expeditionary Sizing of Generators and Loads

How Utilities Marines are Trained to Size Generator Loads



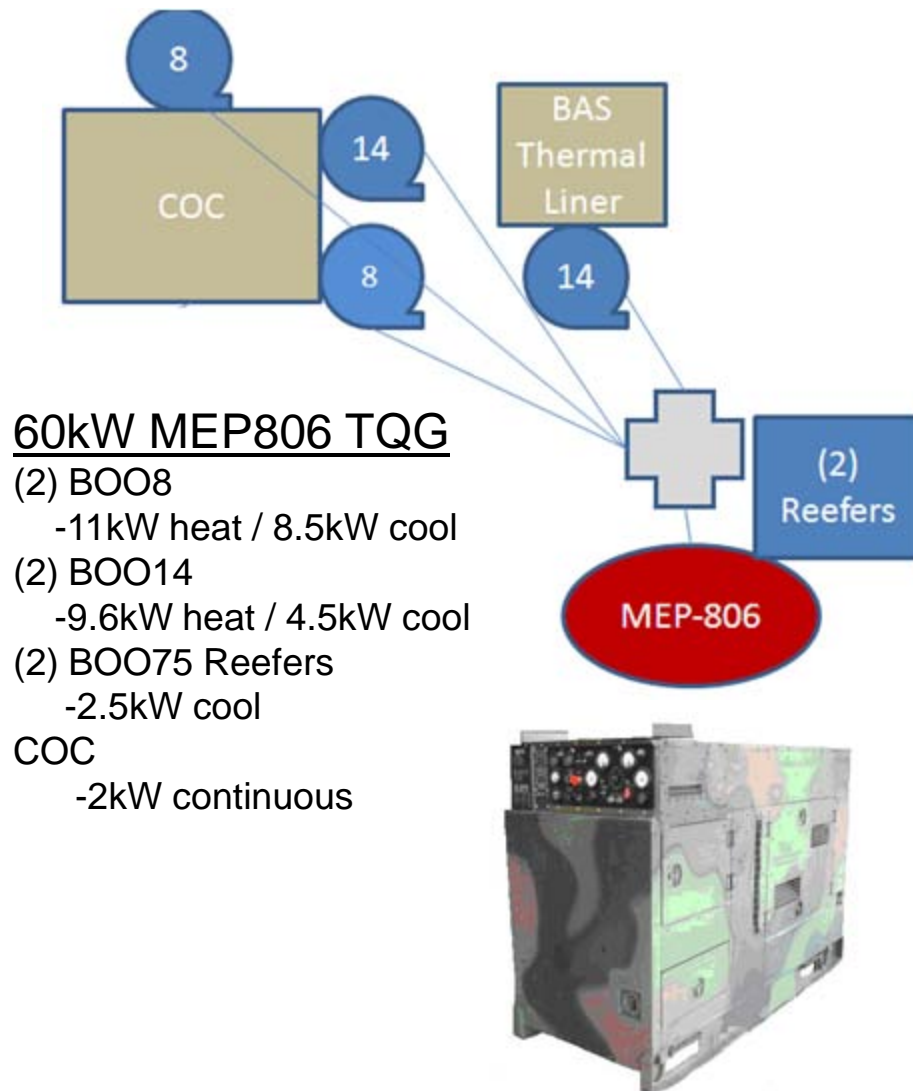
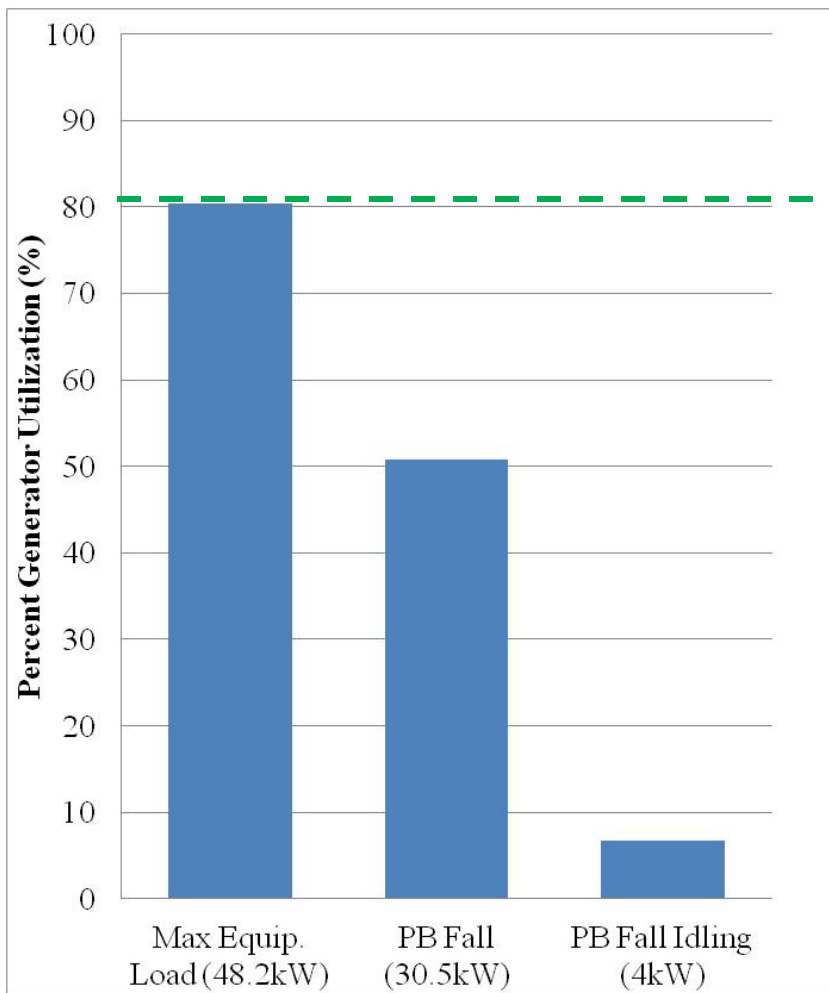
- Calculating Peak Power
 - Utilities Marines focus on calculating peak power draw of each system, regardless of time of year
 - Example: B0008 draws 11 kW when providing heat and 8.5 kW when providing cool air. Therefore a B0008 has a 11 kW peak power draw. This only applies during the winter when the heater is on.
- Sizing a Generator
 - Utilities Marines have an 80% load objective. This allows room for the generator to handle transience and for a small amount of growth
 - After calculating the peak load, they chose a generator size for which the load will constitute 80% of the generators capacity.
 - Example: (2) B0008s and a 2kW COC has a peak load of 24 kW. A 30 kW generator is the appropriate size, since 24 kW represents 80%.

Average 30kW TQG Seasonal Generator Utilization



Distribution A

60kW MEP806 PB (October)





How to Fix the Generator Utilization Problem



Two options exist to fix the generator sizing and utilization problem:

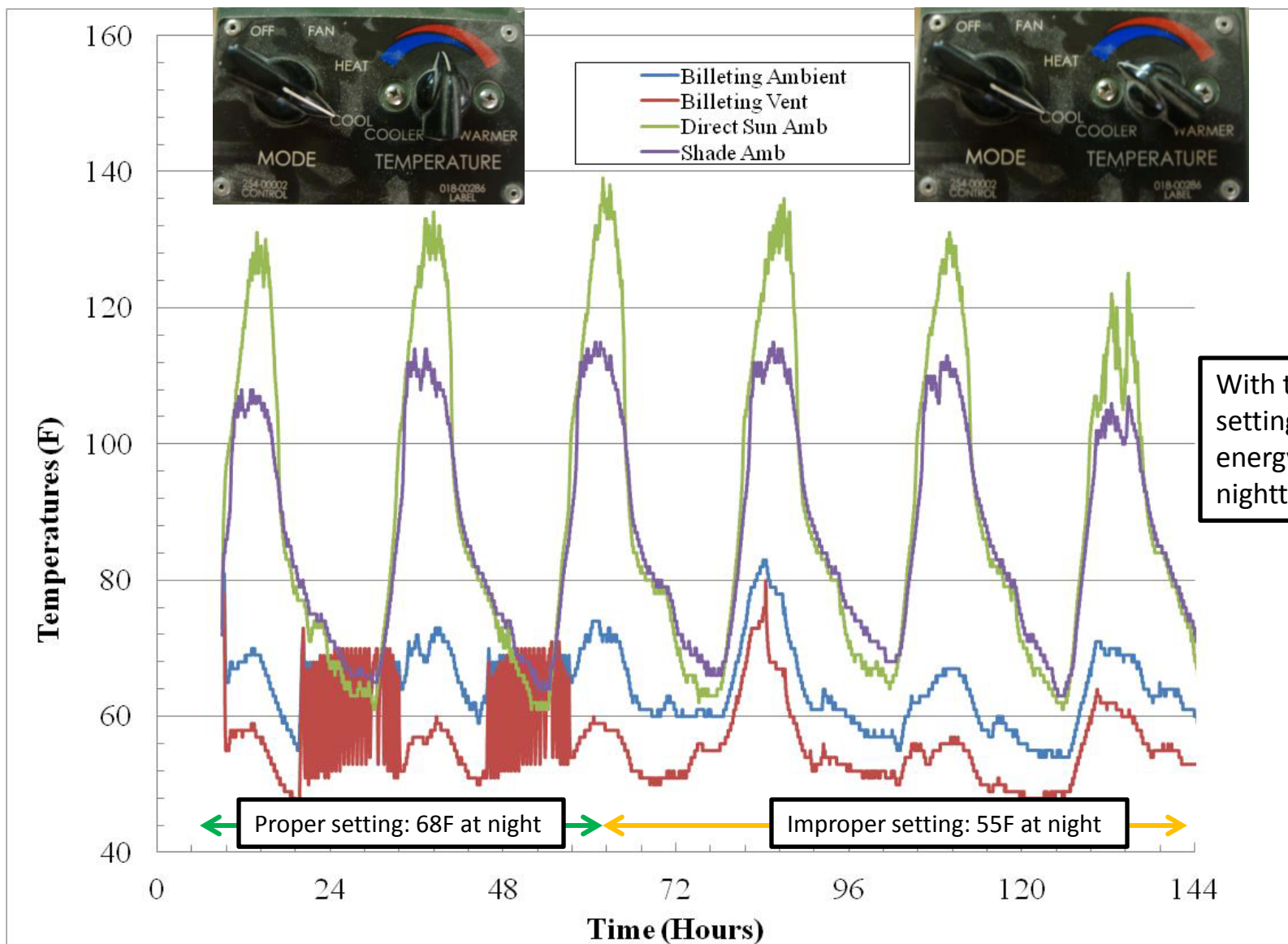
Option A: Rearrange generators twice a year, after winter, and before winter to size them for more appropriate power draws during the remaining 9 months.

- Pros: Non-technical solution. Inexpensive. Simple.
- Cons: Impractical in an environment where it takes months to get a single generator. Utilities Marines would resist the requirement. Additional logistics burden added.

Option B: Hybridize generators. Pros and Cons will be identified in the upcoming AoA, but below is a short list.

- Pros: Simplifies requirements on Marines, reduces generator run times, reduces maintenance, and saves fuel.
- Cons: Expensive up front cost, will require additional training of Utilities Marines, larger up front deployed weight.

Current ECU User Behavior



With the improper setting, ~50% more energy is used during nighttime hours

Assumptions

- It is assumed 6 billeting tents behaved in the same way with the same average load and ECU usage habits
- It is assumed all electrical loads were identified and are listed on the spreadsheet
- It is assumed all equipment remained onsite during the week
- It is assumed the data rate of one sample per minute identified true peak power values
- It is assumed 45 Marines occupied the PB during the test week (only one data sample was taken during the week)
- It is assumed a BOO75 unit draws 1 kW continuous
- It is assumed a GBOSS tower draws 500W continuous
- It is currently assumed ECU's draw zero power when "off" although blower power draw needs to be added
- Data acquisition equipment error is negligible

Results



What does a typical COC load profile look like? ✓

What does a typical Billeting load profile look like? ✓

What is the daily load profile for a COP and below? ✓

How are ECUs being used? What is their contribution to total load? ✓

How can the USMC use it's resources more efficiently?

- Reducing ECU usage is the most critical target for making an impact in fuel usage
 - This can come from technology solutions (Thermostats) or from user behavioral changes (improved ECU confidence, behavioral modification)
- Reducing transient peaks in equipment can also play a key role in improving energy efficiency by enabling the right sizing of generators (Raise target utilization from 80% to 90% or 95%)
- Hybridization/Right sizing generator efforts offer the potential for enormous fuel savings in fall and spring seasons

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Questions or creative solutions?

